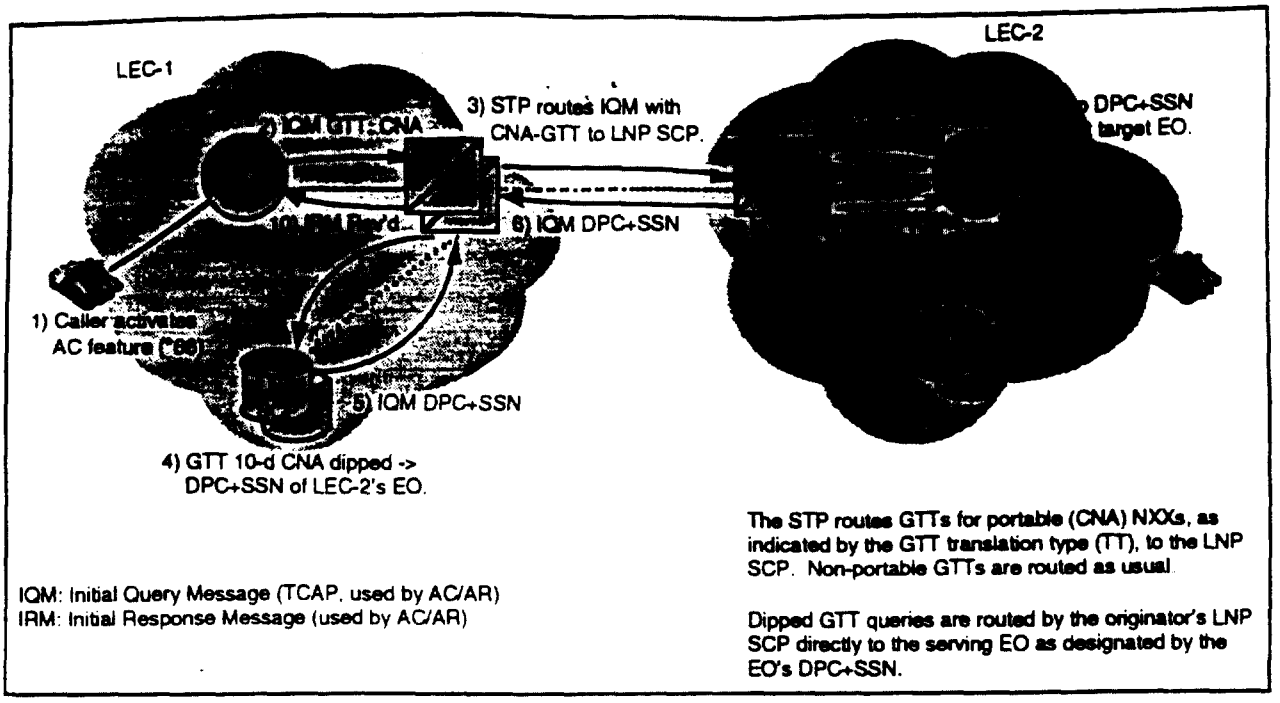


Figure 6 - Direct DPC Routing

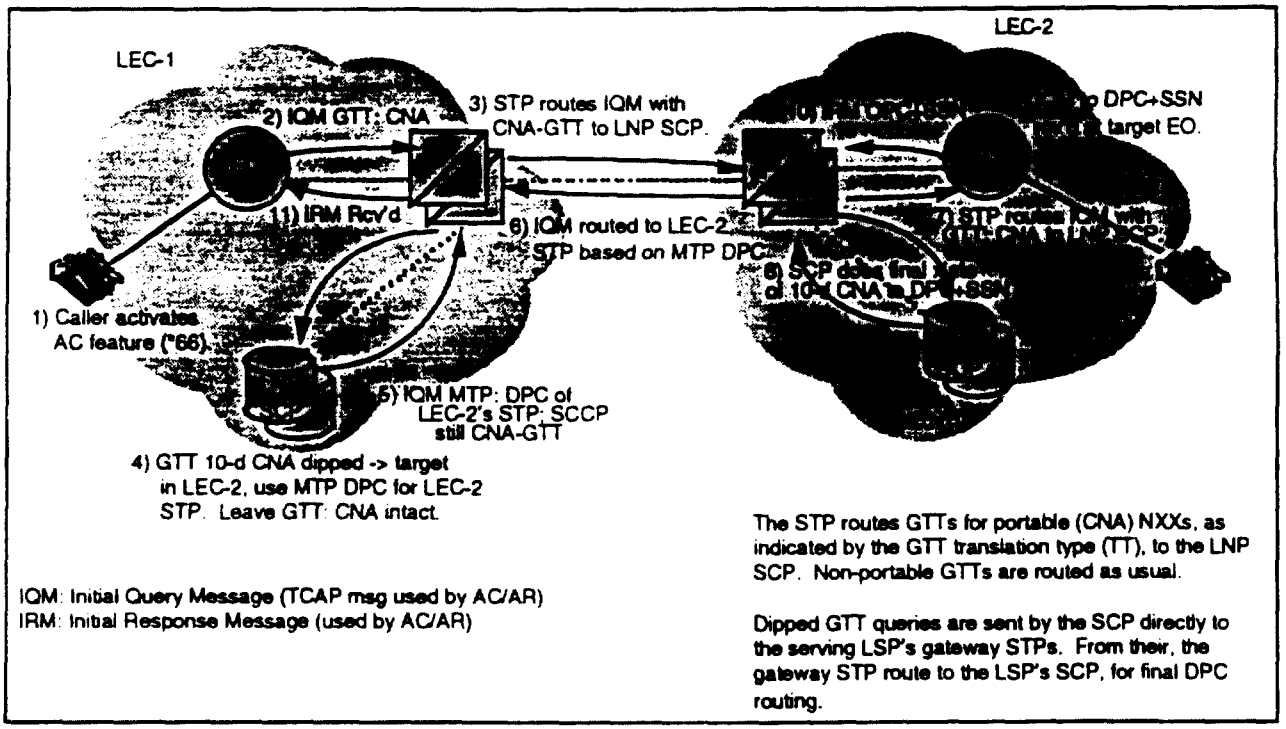


Figure 7 - Gateway DPC Routing

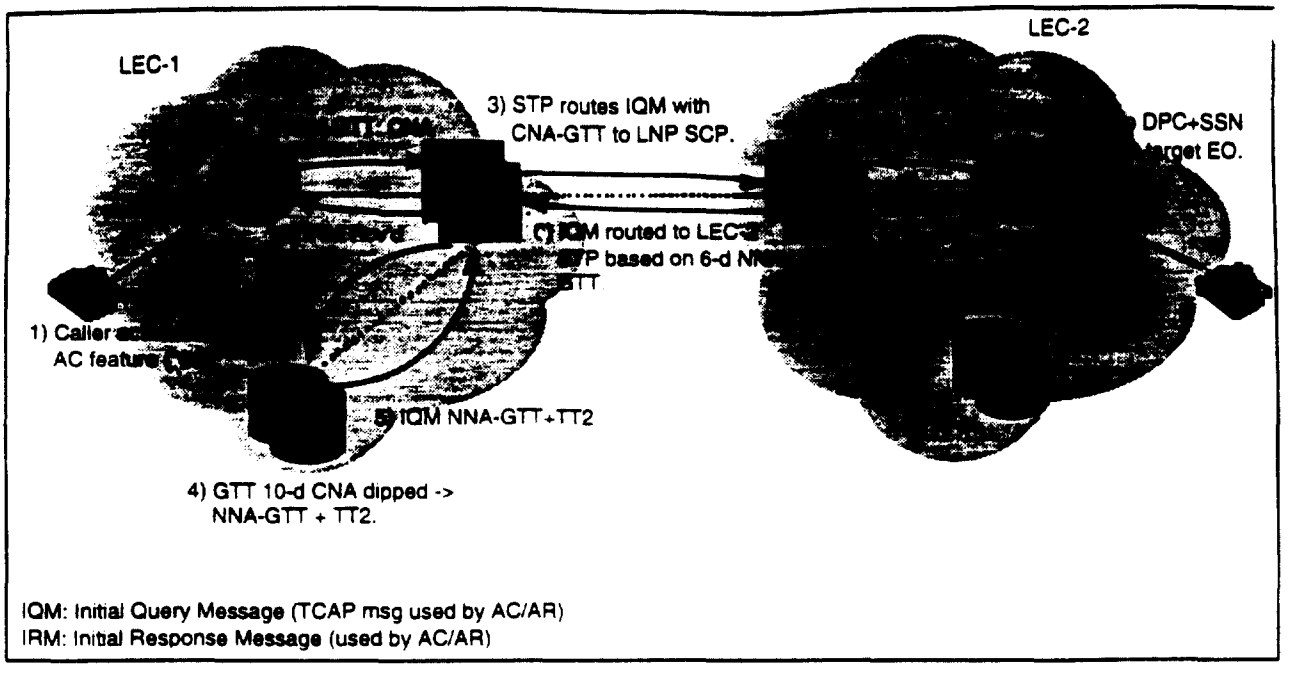


Figure 8 - Replicated GTT Routing

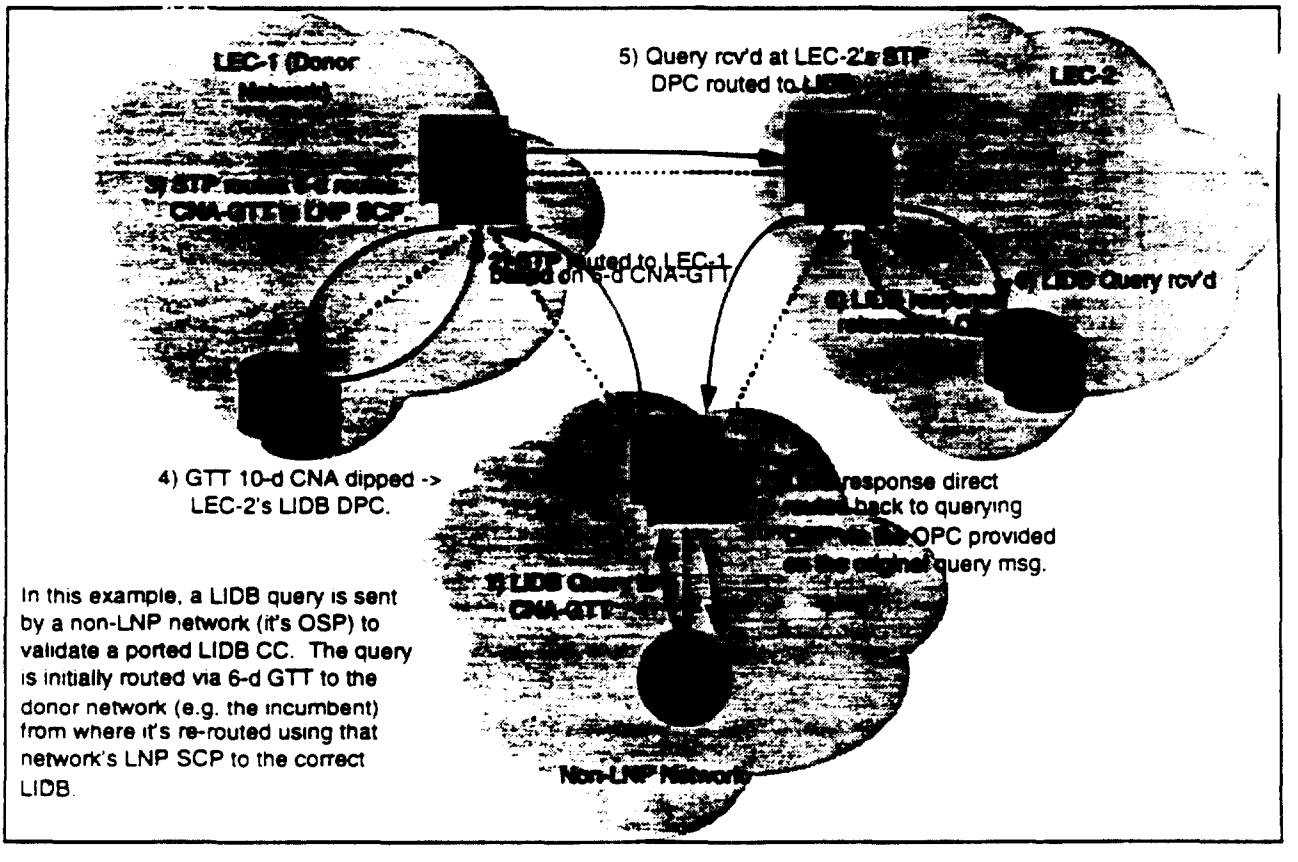


Figure 9 - Example: LIDB Query from Non-LNP Network

13.2.4 Network Impacts

The permanent deployment of LNP will require upgrades to LNP-participating networks as described below. The impacts described are common to the permanent deployment of a database solution.

13.2.4.1 Switching

Participating end-offices will require switch generic upgrades to support LNP-specialized triggering, ported line provisioning, call recording, and incoming ported call translation. Switch generics conforming to LRN will also qualify as LANP conforming. An LANP conforming office need only support one of the ported line addressing modes (e.g. single or split), though the functional differences do not preclude the potential for supporting both simultaneously.

The functional differences between the LNP development required for either addressing mode are: (a) in the LNP trigger, intra-office look-ahead be performed by consulting a different translation table (open DN's vs. public address (CNA) table) depending on the address mode used; (b) in ported line provisioning, with split numbering the CNA and NNA are datafilled in the switch associated with the line to insure the CgPN is populated with CNA value for outbound calls, and that the LNP trigger look-ahead function is able to translate a CNA to line/NNA for intra-office query suppression; and (c) in incoming ported call translation, if the incoming NNA is an single number address (i.e. an LRN) then a CdPN-GAP swap is performed prior to performing line translations.

13.2.4.2 Signaling Standards

As a minimum, T1S1.3 standards work is required to assign new code points for the GAP type, and assignment of an un-used bit in the FCI for the forward dip indicator. These are identical to standards required for LRN. While standards work is required, the assignment of new code points in existing parameters is substantially less onerous than attempting to create entirely new parameters. Additionally, standards work for call recording in connection with location portability is also appropriate -- ISUP parameters are needed to transport this information for downstream call recording availability. The JIP should be standardized for use in ported call origination processing, and a new GDP type code point should be allocated for ported end-user/service-provider/rate-center identification.

Again, the use of existing parameters should prevent impacts to non-LNP capable intermediate switches, to the extent they conform to the letter of T1S1.3. Potential impacts may occur due to: unintended parameter screening; not passing reserved (forward dip indicator is assigned out a currently reserved bit) FCI bits through; screening of unrecognized GAP or GDP parameter types; and screening of multiple GAP parameters, even of different types. These potential issues for non-LNP capable, but LNP conforming, intermediate switches are generic to LANP and LRN.

13.2.4.3 Signaling Networks

As in any SS7 database LNP solution, existing SS7 signaling networks will require upgrading to support the incremental message traffic generated. Additional message traffic is generated by: switch LNP database queries and responses; and

routing affected SS7/TCAP messages via an LNP SCP for 10-digit GTT routing. Changes to STP 6-d GTT routing translation tables will be required to route affected TCAP messages via the LNP SCP.

13.2.4.4 LNP Routing Database

LNP SCP's will be deployed within, or made accessible to, LNP-capable networks to service routing queries from network switches as well as perform 10-digit GTT routing of TCAP messages on behalf of the signaling network.

The LNP database requirements in support of LANP are generic to LNP, as is the LNP administrative infrastructure required to maintain it. Each ported number (CNA) will be stored in the database as a primary lookup key, along with it's associated NNA, TCAP message routing information (e.g. LIDB, end-office routing, HLR routing), and eventually, end-user location identification for call recording purposes.

13.2.4.5 Networks Involved

Networks of service providers who wish to participate in LNP, by porting numbers into and out of their network, will require upgrading. Also, networks of any other involved service providers, i.e. those who may be transporting calls to ported numbers but not necessarily providing local service, may also wish to perform LNP call routing for cost or efficiency reasons and may elect to participate as well. Non LNP-capable networks are not functionally impacted, and continue to perform default routing based on the CNA value.

13.2.4.6 Operational Support Systems (OSS's)

OSS's are seriously impacted by LNP generically, as a result of portability breaking the fundamental identify between a number and it's routing -- an identity with which the PSTN and it's support infrastructure has evolved over the decades. Characterizing the impacts to these systems across the industry is impossible due to the fact that different OSS's and different OSS philosophies are used by different industry segments, e.g.: incumbent LEC's, new entrants, IC's, cellular, and emerging PCS and broadband. These issues differ not just from RBOC to RBOC, even though they use common systems, but even by state to state within a given RBOC's region.

The conclusions offered so far from impacts analysis and trial activities indicate:

1. Different industry segments are impacted disproportionately, depending upon the addressing mode (single vs. split) utilized, if a single one is mandated. No one mode was clearly best for all stakeholders in LNP.

2. The interaction between addressing mode and provisioning mode (which numbers are open in the EO: CNA only; NNA only; or both CNA & NNA) is radically different on different switch types.

3. Secondary switch impacts resulting from LNP were also significant: e.g. open NXX limitations; sparsely populated NXX overhead.

4. Wireless participation in LNP has major impacts, often broader than in the wireline arena. The ability to support a TLDN-like addressing mode for ported call handling may allow wireless providers to defer signaling and switch upgrades to participate.

5. Single number addressing, when used with a rate center-specific, reseller-specific, or large end-user specific NNA allocation policy, generated an identical logical data model (LDM) for the LNP SMS as did using split numbering. Billing-related systems functionality encouraged, rather than discouraged, the allocation of customer-specific NNA's.

6. The intermixed use of both addressing modes did not force different or conflicting OSS impacts, and in some cases avoided the need for significant work to handle special case impacts (e.g. DID, Centrex) where only one addressing mode was used. Intra-service provider OSS impacts could be minimized by crafting addressing and provisioning policies to minimize overall impacts on OSS's and switches.

7. The LDM for the local-area LNP SMS (operated by the LNASC) was not impacted by choice of addressing mode. Consequently there were no inter-service provider impacts as a result of the addressing mode policy employed by individual service providers.

8. Consequently, recognizing the need for service provider's to minimize their own OSS and switch impacts, emphasizing service provider autonomy in these areas (including choice of addressing and provisioning policies) provides maximum impact relief (i.e. diversity principle).

13.2.5 Service Impacts

Preserving network services and features are essential to LNP as is the necessity for effecting ported call routing. Feature transparency is provided in LANP through: elimination of adverse feature-trigger interactions through the development of new LNP-specialized triggers; transparent 10-d GTT routing of TCAP messages (e.g. for CLASS and LIDB/ABS); generation of correct (CNA) CgPN for outbound calls from ported lines in support of so-called ANI-based features; and inbound ported call translation facilities (for both single and split number addressing modes) to insure hand-off of expected called and calling party number values for correct feature operation, e.g. forwarding, DID & ISDN signaling to CPE.

13.2.6 End-User Impacts

LANP imposes no inherent end-user impacts due to direct call routing to actual service office and feature transparency (as described in 0 13.2.5 Service Impacts above).

13.3 MCImetro Carrier Portability Code

This section outlines the Carrier Portability Code developed by MCImetro and its multi-vendor task forces which includes Siemens, Nortel, DSC, and Tandem.

13.3.1 General Description

MCImetro's Local Number Portability (LNP) model is an IN/AIN-based methodology that uses a Local Number Portability database to obtain the routing information necessary to terminate calls to subscribers who have changed Local Service Providers. Local Service Provider is assigned a unique three-digit Carrier Portability Code (CPC) in each LNP area whether Local Access and Transport Area (LATA) or Numbering Plan Area (NPA). This CPC is stored with the Directory Number of the subscriber in the LNP database, and replaces the NPA for call routing purposes.

This LNP solution allows Local Number Portability to be deployed in pockets, or as portability "islands", without requiring extensive changes to the existing network architecture or to the switch software. Because it uses the existing TCAP 800 Intelligent Network (IN) and Advanced Intelligent Network Release 0.1 (AIN 0.1) protocols and triggers, CPC can be introduced seamlessly into local service areas without creating the problems inherent in other LNP concepts.

Specifically, the CPC model offers the following advantages and benefits:

- Proven in prototype testing across five switch types (5ESS, DMS-100, DMS-250, DEX600, and EWSD switches)
- Complete transparency to all subscribers
- Existing IN/AIN 0.1 protocols
- Requires minimal software changes when used with IN architecture
- Of inherent central office routing capabilities
- Supports both Multi-Frequency (MF) and Signaling System 7 (SS7) trunks
- Transparently supports widely deployed subscriber features (e.g., Call Forwarding, Calling Number Delivery, Customer Originated Trace, etc.)
- Compatible with Non-LNP-capable offices

13.3.2 Architecture Description

To provide LNP to a network, the Carrier Portability Code (CPC) solution requires only the addition of the LNP database. The CPC can be any three digits between 200-999, with the exception of SAC, N11, and valid or reserved NPA codes. The CPC

needs to be unique only within the LATA because it is never delivered to an inter-exchange carrier by the originating Local Service Provider.

Since the CPC is in the same format as the NPA, it can be accommodated by either MF or SS7 signaling protocols. This feature offers significant cost advantages, in that existing direct MF routes between non-SS7 capable and SS7-equipped offices can be maintained, and MF overflow trunk groups between end offices remain useable. Incoming calls from non-LNP-capable switches are handled by existing local tandem end office functionality, which treats the call as a local origination.

In this solution, when a switch queries the SCP with the digits NPA-NXX-XXXX, the SCP checks the LNP posted-number database. If it locates the number, it changes the NPA digits to the appropriate CPC digits, and returns CPC-NXX-XXXX to the querying switch. Because non posted numbers need not be stored in the database, the SCP may not find NPA-NXX-XXXX. It then refers to a default table and provides the querying switch with the CPC of the incumbent Local Service Provider for that particular NXX.

With respect to trigger location (i.e., which switch involved in a call issues the query), MCImetro's model follows the industry-accepted N-1 local number portability network hierarchy. Under this hierarchy, participating interexchange carriers are responsible for querying the LNP database for InterLATA calls and for delivering their calls to the proper Local Service Provider. Participating carriers with TCAP capabilities can query the LNP database using either the IN (TR-TSY-000533) or AIN 0.1 (TR-NWT-001284 and TR-NWT-001285) protocols. Companies whose switches do not incorporate these industry-standard protocols must obtain their own copy of the LNP database.

In an LNP environment, the NPA-NXX no longer defines the address (physical location) of a subscriber. To accommodate inter-switch TCAP queries for CLASS features (e.g., Automatic Recall/Automatic Callback), STPs will be required to perform 10-digit Global Title Translation (GTT) for the NPA-NXXs opened for portability to new Local Service Providers. Solutions to this problem are currently being explored: either by having the switch send the CPC-NXX in the GTT query or by having the SCP perform the 10-digit GTT function while the STP continues to perform six-digit GTT.

The CPC solution does not affect features that use the Calling Party Number and redirecting number. For calls that involve features that use a previously stored called- party number (e.g., Call Forwarding, Speed Calling), an LNP database query is necessary to ensure that the current Local Service Provider is used to route the call. Since the query is launched prior to routing the call, a query is not necessary when these features are activated. To ensure that these features work properly on the terminating side, the terminating office must change the CPC back to the corresponding NPA prior to handling the call. However, this is only required for those exceptional cases where 10 digits are delivered to the terminating office (i.e., when the switch serves subscribers in more than one NPA).

The CPC solution can be expanded to offer Location Portability within a rate center. The following paragraphs describe the concept in detail.

In order for calls to subscribers within the same NXX to be served by multiple end offices belonging to the same Local Service Provider, the LNP database must contain a routing address unique to each end office in the portability area. This proposed that each end office within a portability area be assigned a unique 10-digit routing address consisting of the CPC, an NXX that been assigned to the end office in the LERG database, along with a four digit number determined by the new Local Service Provider (CPC-NXX-XXXX). This is very similar to AT&T's LRN model with the exception that the 10-digit routing number is retranslated in the terminating office to the ported subscriber's directory number. This re-translation function, which should
already be available in all end offices, allows location portability to be offered in areas where only MF signaling is available. If SS7 inter-office trunks are widely deployed, our model would follow AT&T's LRN model in that the routing address retrieved from the LNP database will be placed in the Called Party Number field, and the Called Party's number (ported subscriber's DN) will be placed in the Generic Address Parameter field. The originating office would only populate the GAP field if the database returns a routing address (e.g., the last seven digits of the number returned in the query response do NOT match the last seven digits of the called party's number).

In the MF case, when a call is made to the subscriber that has physically moved (708-752-5769), the originating office will launch a query to determine the routing for the call as is done with the CPC model today. The database will respond with a unique10-digit routing address (CPC-488-4952) and the call will be routed to the terminating end office based on normal 6-digit translation of the CPC-NXX digits. This 10-digit routing address identifies both the end office to which the subscriber has moved (CPC-488), as well as an index into the terminating end office's Directory Number translator (708-488-4952, after the CPC has been replaced with the NPA). This index will point to the subscriber's actual directory number (708-752-5769). Once the re-translation is performed, the call will be completed to that directory number.

This solution will initially require the use of two directory numbers for those subscribers using location portability. However, this requirement can be removed once switch vendors implement the SS7 protocol changes required to support the transport of the called party number in the GAP field. The 10-digit routing number would be assigned by the new service provider from a pool of "location routing numbers" set aside in one NXX owned by that Local Service Provider. Since this location portability solution uses existing 6-digit routing based on the CPC-NXX, no changes would be required in Access Tandem offices.

If SS7 is widely deployed, we propose that the Called Party Number (CPN) field be used to transport the 10-digit routing number returned from the LNP database (CPC-488-4952) and the GAP field be used to transport the Called Party Number (708-752-5769). This is no different from AT&T's LRN proposal. If the access tandem determines that only an MF route to the terminating office is available, the called party number in the GAP field is simply discarded. For the short term, this solution could be deployed without the SS7 changes necessary to support the new use of the GAP field for transport of the called party's number, since it can be used in a MF environment. Longer term, the SS7 enhancements would remove the need to perform the re-translation in the terminating office, thus eliminating the need for two DNs for location portability

13.3.3 Method of Operations

Figures 13-1 and 13-2 illustrate the call-processing logic for calls to a ported subscriber via IN and AIN triggers respectively. Numbers in parentheses in the following paragraphs correspond to the circled numbers in the referenced figures.

Figure 13-1 illustrates the flow for an originating call using an IN Trigger:

- A Subscriber initiates the call (1).
- The serving end office determines whether the call is an Inter-LATA call made via 1+ or 10XXX dialing, or a call requiring Operator Services (2). If either of these, the call is routed to the appropriate carrier or operator services switch, using current methods (3).
- If the call is neither an Inter-LATA nor an Operator Services call, the end office determines whether the dialed destination is within a portable NXX by checking its own internal database using the digit translation functions of the switch (4).
- If the dialed number is not within an NXX that is marked as portable, the call is routed normally (5).
- If the dialed number is within a portable NXX, another database check determines whether the NXX is served locally (6).
- If the NXX is local (i.e., the office serves subscribers in that NXX), the office attempts to translate the number to a subscriber (7).
- If the subscriber is served by the local office, the call is an intraswitch call and is routed normally (8).
- If the local office does not provide service for the dialed directory number, the end office prefixes the NPA (if only 7 digits were dialed) and launches a TCAP query sending NPA+NXX-XXXX to the LNP database to determine how to route the call (9).
- The SCP checks the Ported Number database for an entry of the dialed number (10).
- If an entry is found, and the number has a corresponding CPC (11), the SCP sender a TCAP response containing the CPC (CPC-NXX-XXXX) is sent back to the querying office (12), which then routes the call based on this number (13).
- If an entry for the number exists, but the vacant flag is set, the number is vacant, and the SCP responds with the *Play Announcement* message (14).The end office then routes the call to vacant number intercept (15).

- If the number was not found in the Ported Number database, the SCP uses the NPA-NXX of the number to index into the default table to retrieve the CPC of the incumbnt Local Service Provider's CPC) (16).

- the SCP then sends the routing number (CPC-NXX-XXXX) to the querying office in a TCAP response (17), and the call is routed by the end office based on the returned routing number (18).

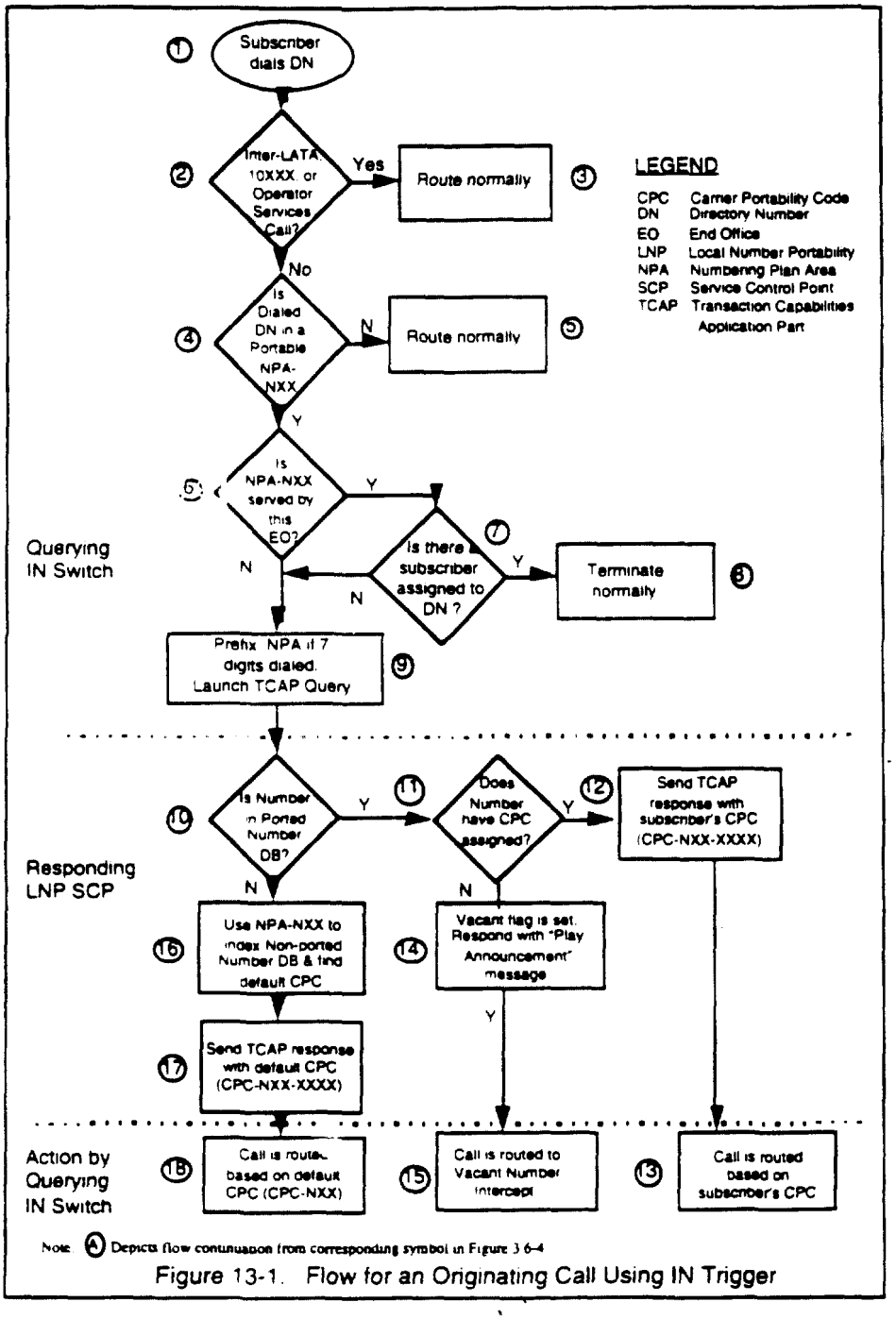


Figure 13-1. Flow for an Originating Call Using IN Trigger

Figure 13-2 depicts the flow for an originating call from a switch using the AIN 0.1 protocol :

- A suscriber initiated the call (1).

- The serving end office compares the dialed digits to the ten digit Public Office Dialing Plan (PODP) Directory Number (DN) list (2). If the dialed number is found, the end office sends an AIN 0.1 *InfoAnalyzed* message to the LNP database (5).

- If an entry is not found in the ten digit PODP DN list, the serving office then compares the NPA-NXX to the six digit PODP DN list (3). If an entry is found, the end office launches an AIN 0.1 *InfoAnalyzed* query to the LNP database (5).

- If an entry is not found, the number is not within a portable NXX, and the call is routed normally (4).

- Upon receipt of the *InfoAnalyzed* message, the SCP determines whether the call was made via 0+ or 10XXX+ dialing. If so, the SCP sends a *Continue* message to the querying office with the dialed digits unchanged (7), and the call is routed to the Operator Services switch or the appropriate carrier (8).

- If 0+ or 10XXX+ was not dialed, the SCP checks the Ported Number database for an entry of the dialed number (9). If an entry is found, and the number has a corresponding CPC (10), an *AnalyzeRoute* message containing the CPC (CPC-NXX-XXXX) is sent back to the querying office (11) which then routes the call based on this number (12).

- If an entry an exists in the Ported Number database , but the vacant flag is set, the number is vacant and the SCP responds with the *SendToResource* message (13). The end office then routes the call to vacant number intercept (14).

- If the number was not found in the Ported Number database (9), the SCP uses the NPA-NXX of the number to index into the default table to retrieve the CPC of the incumbent service provider (15).

- The SCP then sends the routing number (CPC-NXX-XXXX) to the querying office in an *AnalyzeRoute* message (16), and the call is routed by the end office based on the returned routing number (17).

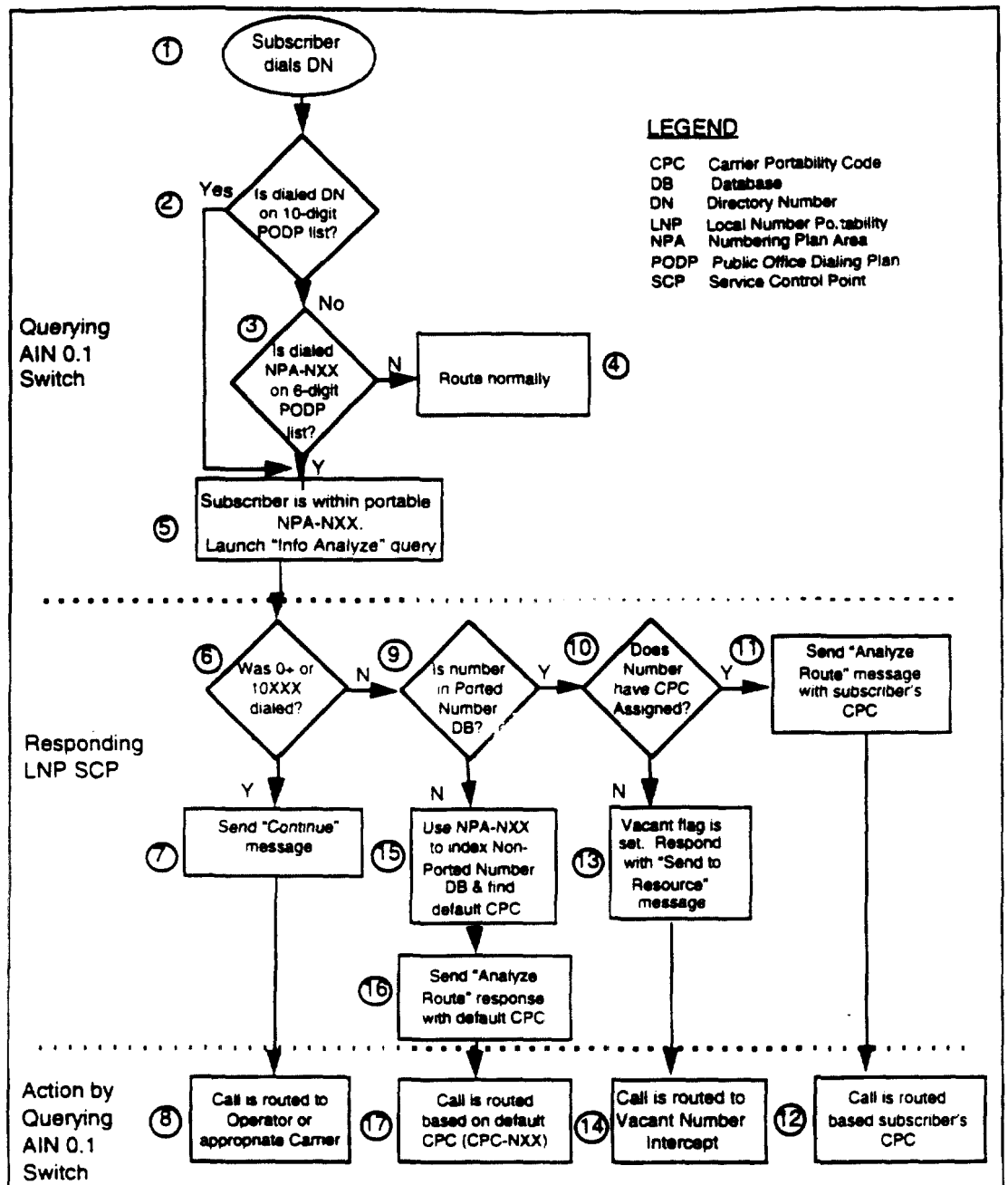


Figure 13-2. Flow for an Originating Call Using AIN 0.1Trigger

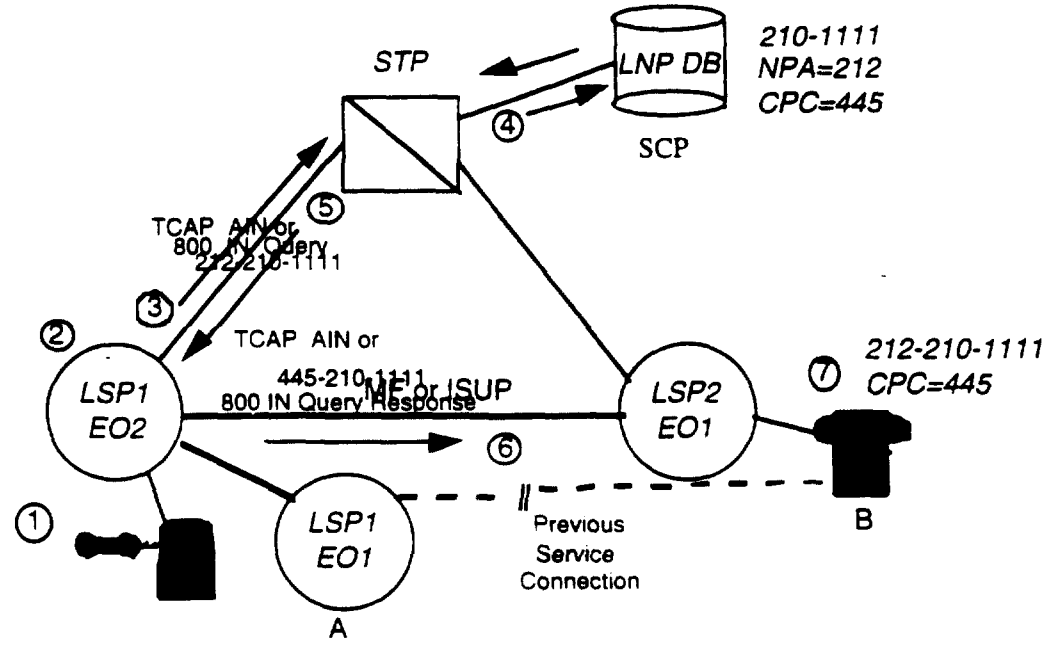
13.3.3 (b) Method of operations based on whether the ported number originates or terminates the call.

The use of the CPC does not introduce any changes to existing call processing or routing. When a ported subscriber initiates a call, the Calling Party Number is the subscriber's Directory Number in the NPA-NXX-XXXX format.

As Figure 13-3 illustrates, when a local call is terminated to a ported subscriber, the originating end office (or an LNP-capable end office) will launch a TCAP 800 IN or AIN 0.1 query to the database to retrieve the subscriber's CPC. The LNP SCP

responds with the CPC + the last seven digits of the Directory Number of the ported subscriber. The call is then routed using existing six-digit translations based on the CPC and the dialed office code (CPC + NXX). The Carrier Portability Code is used only to route the call and is completely transparent to the subscriber.

Naturally, this means that each switch in the portability area must be able to route on CPCs just as it currently does on NPAs.



Subscriber B, located in a portable NPA-NXX, changes from LSP1 to LSP2 without changing DN (212) 210-1111. The new routing flow for subscriber B is as follows:

① Subscriber A calls Subscriber B using 210-2111

② LSP1 EO2 checks its internal Database for presence of Subscriber B. If the DN is not found, a check for ported DN is required.

③ Call is retranslated; TCAP processing prefixes 212 NPA & launches query with 212-210-1111

④ SCP searches its database for 212-210-1111, finds entry with CPC of 445

⑤ SCP sends query response to LSP1 EO2 with 445-210-1111

⑥ LSP1 EO2 translates the call using the new digits (445-210-1111) and routes the call to LSP2 EO1

⑦ LSP2 EO1 completes the call to Subscriber B

LEGEND

AIN	Advanced Intelligent Network
DB	Database
DN	Directory Number
EO	End Office
CPC	Carrier Portability Code
IN	Intelligent Network
ISUP	ISDN User Part
LNP	Local Number Portability
LSP	Local Service Provider
MF	Multi-Frequency
NPA	Numbering Plan Area
STP	Signal Transfer Point
TCAP	Transaction Capabilities Application Part
SCP	Service Control Print

Figure 13-3. Call Flow for a Subscriber Who Has Changed Local Service Providers

13.3.3 (c) Method of operation for intraswitch calls.

When using IN method of query the CPC solution does not require a database query for an intraswitch call (i.e., one that involves only one switch). By reducing traffic on existing 557 links without adversly affecting suscribers this solution yields a performance advantage over models that require database queries for intraswitch calls.

Only using the AIN 0.1 method does the end office initiate a query to the LNP database for Intraswitch calls. The database returns the CPC-NXX-XXX assigned to that end office, which then terminates the call.

13.3.4 Network Impacts

The following subsections describe the impacts of the CPC solution on various parts of the network.

13.3.4.1 Switch

The CPC solution follows the guideline of N-1 switch query to the LNP database. Depending on the call type, this query may be generated by the originating EO or AT, by the N-1 switch in the inter-exchange carrier's network, or in the Cellular carrier's network.

Originating Switch
For local calls, the originating EO switch will generate the LNP query using either the IN or AIN 0.1 method. After the query is answered, the originating switch uses the CPC-NXX-XXXX in the response message to complete the call to the LSP switch identified by the CPC-NXX.

Tandem Switch
If, for a local call, the originating switch cannot query the LNP database, the call may be routed to the Access Tandem switch that is capable of providing such queries. The AT will obtain the CPC-NXX-XXXX information from the SCP and route to the LSP accordingly.

Translation
The CPC model uses the existing 6-digit switch translation and routing mechanisms. The reponses from the LNP SCP are in the NANP form of CPC-NXX-XXXX. Calls may be routed to the appropriate LSP based on the CPC-NXX.

Signaling
Since the CPC is in the same format as the NPA in the called party number, it operates using either MF or SS7 signaling protocols for call setup. This feature offers significant cost advantages by allowing carriers to continue to use existing direct MF routes between non-SS7 capable and SS7-equipped offices can be maintained, and MF overflow trunk groups between end offices can continue to be used.

Database Capacity
The size of the LNP database is minimized by not including non-ported numbers (numbers still being served by the incumbent Local Service Provider). When a non-ported number is received in an LNP query, the SCP will simply respond by sending back the default CPC for the NPA-NXX (CPC-NXX-XXXX), and the querying

end office will route the call to the current Local Service Provider using existing six-digit routing functionality.

As local number portability is widely deployed, no individual office will actually own a portable NXX. Hence, vacant number processing will be handled by the SCP.

Interworking
The CPC solution minimizes interworking with existing systems and processes by using a single number solution, by using existing standards for querying, and by supporting both SS7/ISUP and MF signaling for call setup.

Number of SCPs
The CPC solution is not dependent on any single vendor and does not require a specific number of SCPs to be deployed. The LNP SCP may be deployed centrally, regionally, or locally. There may be multiple copies of the Database may be maintained in different networks, in that case, database synchronizaton is critical. The service management system provide updates to multiple SCPs if required.

Query demand
By minimizing the number of LNP database queries, significant cost and performance advantages are obtained. The CPC model requires an LNP database query only when the dialed Intra-LATA number is not in the originating end office's database and the NPA-NXX is marked in the originating end office's routing translations as being "portable". CPC does not require an LNP database query by the originating Local Service Provider using either the Intelligent Network (TR-TSY-000533) or the AIN 0.1 implementation approach for any of the following calls :

- Local terminating calls to numbers housed in the switch database
- Any Inter-LATA call type (routed to the carrier)
- Calls from LNP-capable switches
- Calls to unpopulated Centrex intercom numbers
- Calls to NPA-NXXs where portability is not allowed
- Calls where the dialed number is SAC code or other special number.

13.3.4.2 Post Dial Delay

The TCAP response time is estimated to be 150 to 300 milliseconds for a round trip-query and response from an SSP to an SCP and back. This is the only additonal post dial time for subscribers in portable NPA-NXXs.

13.3.4.3 E911 Impacts

CPC has no impacts on existing 911 service. Ported subscribers will continue to dial 911 to reach a Public Safety Service Answering Point (PSAP). Where the operator obtains calling and location information verbally from the caller, LNP does not change this interaction.

For Enhanced 911 (E911) service, the PSAP operator must receive the correct Automatic Number Identification (ANI) for the caller in order to retrieve the correct information from the Automatic Location Identification (ALI) database. CPC leaves the ANI unchanged; it is the subscriber's NPA-NXX-XXXX. As a result, E911 calls from ported subscribers will process normally.

In an area with multiple Local Service Providers, each LSP with a PSAP must provide access between this PSAP and the ALI database. Each LSP must either serve its ported (and non-ported) subscribers using a PSAP based in its network, or make arrangements with another LSP to route E911 calls to their PSAPs.

13.3.4.4 SMS Database

The SMS solution is independent of the LNP solution, and should be evaluated with different criteria.

13.3.4.5 SCP Database Responses

The CPC model is based on current standards, requires little or no development, and supports the many different network implementations currently deployed. It offers a choice of implementation via either an IN or AIN 0.1 protocol.

The IN interface was developed as another application of the TCAP 800 protocol and requires minimal changes to switch software.

The AIN 0.1 approach utilizes the Public Office Dialing Plan (PODP), or 3/6/10, trigger. Other possible AIN 0.1 implementations to implement an alternative AIN 0.1 trigger in long term are being explored.

The LNP database is comprised of two data tables. One contains Ported and Vacant Directory Numbers (DNs); the second, is a default table that shows the CPC of the incumbent service provider. When a query is received, the SCP first uses all ten digits of the DN to search the ported/vacant DN .

As Table 13.3-1 suggests, a successful search of this database will retrieve either the CPC of the called subscriber's new Local Service Provider, or it will find that the number is not assigned, and the LNP SCP will return " Vacant Number Intercept" treatment.

Table 13.3-1 Format of the Ported Number / Vacant DN Database

Directory Number	Carrier Portability Code	Vacant (Y/N)
NPA-NXX-XXXX	XXX	N
NPA-NXX-XXXY	YYY	N
NPA-NXX-XXZZ	---	Y

13.3.4.6 Type of Number Portability Supported

The CPC solution supports Service Provider Portability, Service Portability, and Location Portability within a confined area that will be determined by the industry. The CPC solution does not dictate the confined area.

13.3.4.7 Service Interactions

CLASS Features
In an LNP environment, the NPA-NXX no longer defines the address (physical location) of a subscriber. To accommodate TCAP queries between switches for CLASS features (e.g., Automatic Callback/Automatic Recall), STPs will be required to perform 10-digit Global Title Translation (GTT) for the NPA-NXXs opened for portability.

Additionally, some triggering conflict occurs between the PODP and the AC/AR when using the AIN 0.1 based protocol to query the LNP SCP. This may be resolved by removing the restriction on the PODP trigger.

Switch Features
The CPC solution does not affect features that use the Calling Party Number and redirecting number. For calls that involve features that use a previously stored called- party number (e.g., Call Forwarding, Speed Calling), an LNP database query is necessary to ensure that the current Local Service Provider is used to route the call. Since the query is launched prior to routing the call, a query is not necessary when these features are activated. To ensure that these features work properly on the terminating side, the terminating office must change the CPC back to the corresponding NPA prior to handling the call. However, this is only required for those exceptional cases where 10 digits are delivered to the terminating office (i.e., when the switch serves subscribers in more than one NPA).

ISDN
ISDN interworking is similar to general interworking requirements previously discussed. CPC does not introduce any ISDN-specific interworking issues.

Call Forwarding
The CPC method does not affect the Calling Party Number and redirecting number. Using Called Party Number necessitates an LNP database query to ensure that the current Local Service Provider is used to route the call. Since the query is launched prior to routing the call, a query is not necessary when this features is activated. To ensure that these features work properly on the terminating side, the terminating office must change the CPC back to the corresponding NPA prior to handling the call. However, this is only required for those exceptional cases where 10 digits are delivered to the terminating office (i.e., when the switch serves subscribers in more than one NPA).

13.3.4.8 Number Administration

The CPC solution functions using either a centralized or a de-centralized database. The industry will decide on database set-up and administration. MCImetro believes that large service providers (both LECs and IXCs) will want to have their own databases, which will be synchronized by a SMS system. A database provider

may supply database services to small service providers. Although the independent database provider will not supply any proprietary information, service providers that own their own databases will likely have proprietary information along with CPC codes in their databases.

13.3.4.9 Operator Services Impact

Several possible options exist for connecting to operator centers. One possible configuration is for all Local Service Providers to be served by one operator center, which will have direct or indirect connectivity to the LSP switches. This configuration is used in the call-flow scenarios in Section 7. Another possibility is for each LSP to have its own operator center connected to their own switches. This configuration requires signaling compatibility between operator centers in order to transfer calls.

Line Information Database (LIDB) access is required for such operator services as Collect Calls and Third Party Billing Number Screening. Since the CPC model uses the actual subscriber's number (NPA-NXX-XXXX), there is no impact on LIDB-supported functions. However, as a result of local competition in some areas, each Local Service Provider may have its own LIDB that contains only information for its subscribers. The existence of multiple LIDBs in a geographical area will require 10-digit Global Title Translation at the STPs to query the appropriate LIDB. The CPC solution does not affect the format or the information stored in LIDBs, nor does it impact the format and the content of the LIDB query or response messages. The following responses assume that each LSP will have its own LIDB.

Since the CPC method does not affect the actual subscriber's number (NPA-NXX-XXXX), the impact to the existing operator center databases is minimized. The CPC solution requires the operator center to support LNP translation, which can be accomplished by querying the LNP SCP or by keeping a local copy of the LNP database.

Busy Line Verification
The lack of clear Busy Line Verification (BLV) signaling standards makes it very difficult to devise a solution for the switches to perform the LNP query. This is one of the reasons why the LNP query is to be done at the operator center.

Third Number Billing
In the CPC model, operator calls are routed to the operator center with the original dialed number intact. After the operator collects the appropriate information, the call extension leg is treated as a new call by the SSP, and may encounter an LNP query based on the Called Party Number. These services are not affected by the CPC solution.

A third party-billing call involves three call legs. The most complex situation occurs when each of the parties involved in the call is served by a different LSP, each with its own LIDB. Assume that Subscriber A initiates a third-party call by dialing 0- or 0+NPA-NXX-XXXX (1). The Local Service Provider delivers the call to the operator center (2), where an operator receives a request from Subscriber A to complete a 3rd party call to subscriber B, who is served by LSP2, and charge it to Subscriber C, who is served by LSP3. The operator performs a billing-number screening on Subscriber C by launching a LIDB query to the LSP3's LIDB. If the

screening is successful, the operator then initiates a call to Subscriber C for verbal verification. The call from operator to subscriber C is treated as a new call by the serving switch and a LNP database query is performed. The LNP database returns the CPC-NXX-XXXX for Subscriber C. If subscriber C accepts the charges, the operator then releases the call to subscriber C and initiates a call to subscriber B. Again the call from the operator to Subscriber B is treated as a new call by the serving switch and it initiates an LNP database query. The LNP database returns the CPC-NXX-XXXX for Subscriber B, and the call is completed to LSP2 switch and to subscriber B.

Emergency Calls

When an operator receives an emergency call today, an emergency number database query is made based on the originator's directory number. The result is either a PSAP address or the appropriate emergency service provider such as hospital, fire station, etc.. The CPC method does not manipulate the calling party's directory number, therefore it does not impact the emergency databases. However, after location portability has been implemented, the directory number may not be linked to the location of the caller. In this case, an LNP query may be required to approximate the location of the subscriber.

0+ or 0- Calls

0+ or 0- is an access method to the operator. Typically, 0+ calls are either collect or calling-card calls. 0- calls will route directly to an operator or an operator menu and the calling party may request any available service. Using the CPC method, a calling party's directory number may be delivered to the operator for any type of necessary operator processing.

Collect or calling-card call processing requires a LIDB query to the correct LIDB provider, which requires a 10-digit Global Title Translation. Since the format of the called party number is not changed there are no impacts to the LIDB. Collect-call processing is similar to 3rd-Party billing calls; the only difference is that the billing party is the terminating party.

The CPC solution does not affect any calling-card services. For LIDB-based calling-card services, the originating operator center must query the correct LIDB database for card validation using 10-digit Global Title Translation. The format of the LIDB query and the information content of the messages is not impacted by the CPC solution. After successful LIDB query, the call is completed to the destination number. If the destination number is in a portable area, the serving operator switch must perform an LNP database query.

Directory Assistance

Directory Assistance services are provided by the originating line's serving LSP unless a different access number, (e.g., an 800 number) is dialed. In this case, the call is routed to the 800 number location based on 800 call routing. Just as with operator services centers, the LSPs may choose to have one DA center serve several LSPs, or each may have its own DA center. For efficient operation, the local DA database must contain all the numbers within a local area, regardless of the service provider.

The CPC solution does not impact the format of the DA database fields or search logic. Portability will be transparent to the DA center. If call completion is requested, a new call is initiated from the DA center to the destination number. If

the destination number is a portable number, the N-1 switch will be responsible for providing an LNP query.

Public Telephone/Customer-owned Coin-operated telephone (COCOTS)
As previously discussed, CPC does not change the originating-line number information and, therefore does not change any screening requirements for coin lines. The originating lines' service provider is responsible for providing TSPS capability for public Coin phones. If the call terminates to a portable number, the N-1 switch is responsible for performing an LNP database query for translation to CPC-NXX-XXXX. As long as the portability area is within a rate center, the originating provider will be able to rate the call based on the originating and terminating NPA-NXX-XXXX, and will not require an LNP query at the originating switch.

13.3.4.10 Timing/Availability

The CPC solution has been in development since October 1994 when MCImetro assembled its multi- vendor LNP task force. Development of the Tandem SCP was completed in April 1995. The overall solution will be implemented in the NY State trial by February 1996.

No standards work is required for CPC to work in the network, but MCImetro believes that efficiencies can be gained if a dedicated trigger is allotted just for LNP and if a few other standards changes are initiated.

13.3.4.11 SS7 Impacts

The solution fully complies with the requirement of being based on the use of SS7 and an intelligent network; moreover, it provides maximum flexibility by allowing participating carriers the option of implementing the model via either an IN or AIN 0.1 architecture.

New Messages
The CPC solution maximizes the use of existing protocols, using either the TCAP 800 IN (TR-TSY-000533) or AIN 0.1 (TR-NWT-001284 and TR-NWT-001285) protocols to query the SCP for a translation of the dialed number (NPA-NXX-XXXX) to the routing number (CPC-NXX-XXXX). Since the CPC is in the same format as the NPA, it can be accommodated by either MF or SS7 signaling protocols for call setup procedure. The CPC does not require any new messages or changes to existing messages.

Capacity
Capacity impacts depend on several factors, including the topology, SCP and Switch Vendors, and number of ported NXX. The CPC solution provides an efficient method of querying the LNP SCP and minimizes unnecessary or multiple queries per call, hence it does not introduce any additional capacity constraints.

The MCImetro laboratory continues to assess capacity impacts and performance measurements.

New Standards
The CPC solution uses the following existing standards for the LNP SCP access:

- TCAP 800 IN (TR-TSY-000533) or
- AIN 0.1 (TR-NWT-001284 and TR-NWT-001285)

As a result of some prohibiting triggering mechanisms in AIN 0.1, the use of a PODP trigger for querying the LNP SCP introduces some interworking issues with the Automatic Recall and Automatic Call Back features. This interworking issues must be addressed by the standard bodies.

13.3.4.12 Relative Cost

A cost model for the CPC solution is currently under development. Results of these studies will be provided as soon as they are available.

13.3.4.13 Billing/Rating

The solution permits both the measured billing and the bulk-rate billing methods currently in use. The Carrier Portability Code (CPC) is used only for routing and does not affect the calling party's ANI. It uses AMA-record billing, with an AMA record that reflects the actual ANI of both the ported number and the dialed number.

Every possible effort will be made to minimize impacts to embedded billing and settlement processes. Depending on the capabilities of different switching systems, minor modifications may be required in some carriers' switches to create the appropriate AMA record.

13.3.4.14 End User Impact

Toll Indicator/caller confusion
The CPC solution supports LNP within a rate center.

Transparency
CPC achieves its goal of providing complete transparency to the end user. Under the CPC method, a subscriber changes LSP with no interruption of service. The CPC method does not introduce any changes to existing dialing plans, and does not affect any end-user service interactions.

Ubiquity
The CPC solution has made provisions to accommodate non-LNP capable switches in order to provide a ubiquitous service. However, true ubiquity will be dependent of the different network implementations and level of participation.

Directory Listing
Directory listing databases will continue to use the subscribers' Directory Numbers. Depending upon implementation, there may be one Directory Listing Database per LSP; however, efficiency dictates that the local Directory listing

database contain all the numbers within a local area regardless of the service provider.

Repair
In order to provide a uniform Repair number, such as 611, repair calls should be routed to an automated system that determines a caller's directory number. Then the system can perform an LNP query and route the call to the appropriate LSP repair center.

An alternative is to provide LSP specific repair numbers such as an 800 number which will then directly route to the appropriate LSP repair center.

Number Change requirement
During the period when a subscriber has requested a change-number announcement, his old number will be unavailable and the last service provider before the change will be responsible for providing the Number Change treatment. Calls to the changed number will encounter LNP query as appropriate, and will be routed to the last Service Provider.

No Number Change Requirement
If a subscriber changes a number and does not request a Number change announcement, the number will become available and will be treated as a vacant number. Vacant numbers are marked in the LNP SCP, and the querying switch is responsible for providing Vacant number treatment as described herein.

13.3.4.15 Participating Carriers

The CPC solution allows Local Number Portability to be deployed in pockets, or as portability "islands," without requiring extensive changes to the existing network architecture or to the switch software.

All participating companies providing LNP-capable switches will be required to establish SS7 connectivity between their switches and the LNP SCP. Calls from non-LNP-capable switches to ported numbers can easily be accommodated by either MF or SS7 connectivity to an LNP-capable switch using existing local tandem end-office functionality, which treats the call as a local origination.

With respect to trigger location (i.e., which switch involved in a call issues the query), MCImetro's model follows the industry-accepted, N-1 local number portability network hierarchy. Under this hierarchy, participating interexchange carriers are responsible for querying the LNP database for InterLATA calls and for delivering them to the proper Local Service Provider. Participating carriers with TCAP capabilities can query the LNP database using either the IN (TR-TSY-000533) or AIN 0.1 (TR-NWT-001284 and TR-NWT-001285) protocols. Companies that do not have these industry-standard protocols deployed in their switches will need to make provisions to obtain their own copy of the LNP database.

Provisioning required to open an exchange to portability

When an exchange is opened to subscriber portability, changes are required in the following four network elements:

- each LNP-capable switch that routes on a six-digit basis to the exchange
- the donor switch (i.e. the switch that "owns" the NPA-NXX, as defined in the Local Exchange Routing Guide, or LERG)
- all network STPs
- the LNP database.

Each LNP-capable switch that routes to the newly ported exchange on a six-digit basis must mark the exchange as portable. In the AIN 0.1 case, this is done by adding the NPA-NXX to the PODP trigger list. IN variations will be platform specific; marking an NPA-NXX as portable causes the switch to begin querying all calls to the exchange.

The donor switch must begin querying intraswitch calls to the NPA-NXX. The AIN 0.1 implementation can be performed on a 6-digit or 10-digit basis. In the 6-digit case, the newly portable NPA-NXX is placed into the PODP trigger list. For 10-digit triggering, each vacant DN is added to the PODP trigger list. As DNs are ported away from a switch using 10-digit PODP triggers, each ported DN must be added to the PODP trigger list. Similarly, with IN-equipped switches, the NPA-NXX (6-digit basis) or each ported and vacant DN (10-digit basis) must be marked as requiring LNP queries. As a fail-safe measure, all Directory Numbers that have been marked vacant in the LNP database must be set at the donor switch to query the database for terminating attempts. This will capture calls to ported numbers that should have been rerouted to another Local Service Provider but were not due to a failure at some point in the call routing.

Each STP must be prepared to support 10-digit Global Title Translation for calls to the new portable NPA-NXX. No other initialization work is required on a per-exchange basis.

Information on currently vacant DNs in the newly portable exchange must be copied into the LNP Database. The CPC solution requires no other NPA-NXX initialization work, provided the donor switch is using an interface compliant with TR-TSY-000533, TR-NWT-001285, and TR-NWT-001284.

13.4 RTP Proposal

13.4.1 General

This proposal uses a generic network capability - Release To Pivot (RTP) to accomplish service provider portability. Calls using RTP will attempt to complete as they presently do to a switch that is assigned a given NPA-NXX. If a dialed number has been ported from the switch, the call will be released back to a previous switch in the call path for rerouting to its new location. By releasing the call back, service providers can ensure that calls are efficiently routed in a number portability environment. When the call is released back, Rerouting Information (RI) is included so that the call can be completed to the new location. If the dialed number has not been ported from the switch, the call will complete as it does today. This functionality is accomplished by equipping switches in a network with Release and Pivot functionality. The functionalities can be resident in the same switch or can be in separate switches.

13.4.2 Architecture Description

RTP uses existing switching infrastructure and signaling network to accomplish service provider portability; an external database is not required. If the Release switch and Pivot switch are separate switches it is necessary that they, as well as any switches between them, be SS7 capable. In addition, switches between the Pivot switch and the Destination switch must be SS7 capable. Other switches in the call path need not be SS7 capable. The key network components required are switches (End Office and Tandem), interoffice facilities, STPs, and SS7 signaling links.

13.4.3 Method of Operations

The following steps describe one example of a call to a ported number using RTP. In this scenario, the customer (510-999-0000) has ported from LEC-A to LEC-B. Refer to Figure 1.

1. A switch (P) that is Pivot capable either originates a call or is in the Forward routing call path of a call. Switch P determines that the call should proceed to switch R which is Release capable. Switch P formulates an IAM for delivery to switch R which contains a Capability Indicator (CI) which informs switch R that a call can be released back to switch P to utilize switch P's Pivot functionality. The IAM + CI is sent to switch R.

2. Upon receipt of the IAM + CI, switch R tries to complete the call. Switch R determines, based on a translation table that the called number has been ported to LEC-B. Since a CI has been sent, Switch R utilizes its Release functionality and formulates a Release (REL) message for delivery back to switch P. The REL message contains a cause value

(RTP) and a Location Routing Number (LRN) which identifies a switch in LEC-B's network. The LRN is included in the REL message as the Redirection Number. The REL + RI is sent to switch P.

3. Switch P, upon receipt of the REL + RI, accesses a translation table and determines routing based on the first 6 digits of the LRN. A new IAM is formulated and the call is redirected to switch D which is in LEC-B's network with the LRN in the Called Party Number parameter, the dialed number in the Generic Address Parameter, and a Forward Call Indicator that identifies that the number has been translated and no further queries are required.

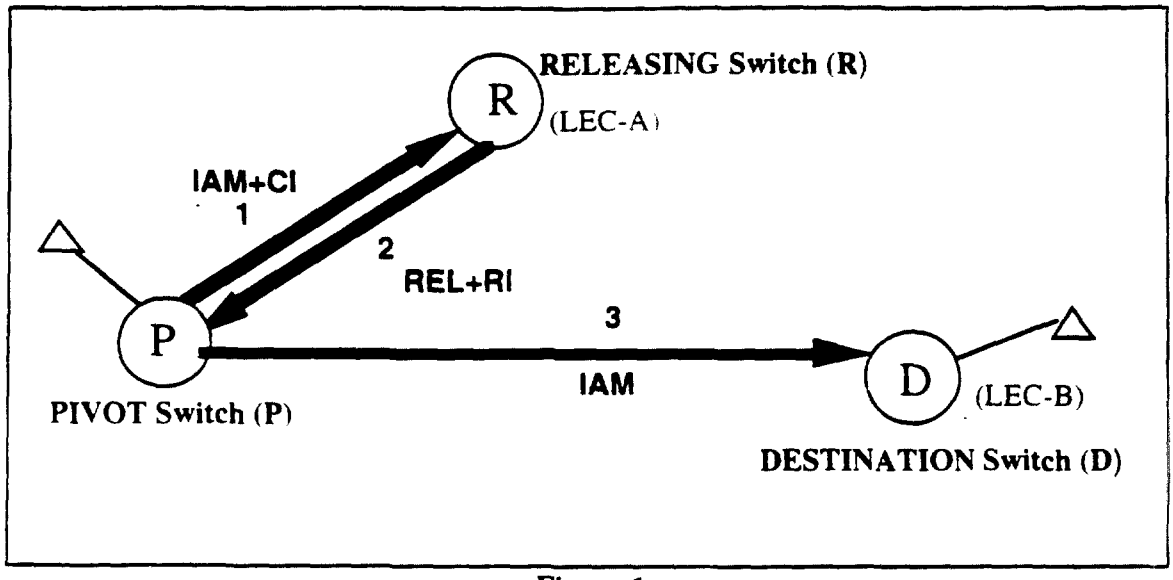


Figure 1

13.4.4 Network Impacts

13.4.4.1 Switch

There is no impact to the originating switch if it is not the Pivot or Release switch. Tandem switches may be required to be Pivot capable. Translation changes will be required in Pivot switches, Release switches, and Destination switches with RTP. SS7 signaling is required between the Pivot switch and the Release switch -- other switches need not be SS7 capable.

13.4.4.2 Post Dial Delay

RTP will not increase incremental call setup time or post dial delay for calls to non-ported numbers. The incremental call setup time and post dial delay for calls to ported numbers has not been verified in a live network but will primarily consist of the time to send an IAM (with CI), determine the number has been ported from the Release switch, formulate and send a REL (with RI) message, and the time to translate the RI information into a new IAM (or equivalent) for forwarding to the final destination switch.